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FOREST RESOURCES OF NORTHEAST TEXAS

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A Progress Report by

THE SOUTHERN FOREST SURVEY

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FOREWORD

The nation-wide Forest Survey, being conducted by the United States Forest Service, was authorized by the McSweeney-McNary Forest Research Act of 1928. Its five-fold object is: (1) to make an inventory of the present supply of timber and other forest products; (2) to ascertain the rate at which this supply is being increased through growth, (3) to determine the rate at which this supply is being diminished through industrial and local use, windfall, fire, and disease, (4) to determine the present requirement and the probable future trend in the requirement for timber and other forest products; and (5) to correlate these findings with existing and anticipated economic conditions, in order that policies may be formulated for the effective use of land suitable for forest production.

This release is based on a field survey made April 13, 1935, to August 24, 1935, and three field canvasses of forest industrial plants to determine forest drain, the last of which was made during January 1938. It should be regarded only as a progress report since it contains Forest Survey data that will be included in complete reports to be published later, and that, although considered reliable, are subject to correction or amplification as the work of computation proceeds. Item 4 above, which is being studied on a national basis, is not discussed in this report.

In the presentation of these survey data, it is to be noted that owing to the sampling method used in collecting them, the greater the number of samples in any given classification the more accurate are the data for that classification. Hence classes that are of infrequent occurrence and relatively small in quantity generally cannot be determined with as high a degree of accuracy as classes that occur more frequently and in substantially greater quantities. Small tabular items are to be taken as showing, not the exact magnitude of the classes involved, but their relative magnitude in comparison with those of other classes.

In the South, the Forest Survey functions as an activity of the Southern Forest Experiment Station with headquarters at New Orleans, La.

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FOREST RESOURCES OF NORTHEAST TEXAS

General Description of the Unit

Notwithstanding its importance, the timber resource of northeast Texas has been overshadowed in recent years by the petroleum industry. Until 1930 agriculture and the forest industries were the chief sources of livelihood for the people of the area, but with the drilling of the Joiner well in 1930, and the oil boom of 1931 and 1932, the area quickly became the largest oil field in the world and produced about 176 million barrels of petroleum in 1935. The petroleum industry, however, actually utilizes only a small proportion of the land surface. Exclusive of lands under lease, the area occupied by oil wells is probably less than 300,000 acres, forming a belt not more than 8 miles wide and 50 miles long, extending from northeast to southwest through Cherokee, Rusk, Smith, Gregg, and Upshur Counties. These counties are included in the forested counties of northeast Texas, the timber resource of which is discussed in this report.

The area of the survey unit under consideration consists of 19 counties located in the northeastern corner of the State (fig. 3). The gross land area is 8,622,100 acres, nearly 46 percent of which is forest land. Agriculture, petroleum, and forest industries employ a large proportion of the population. There are no large cities in the area, but Tyler, Longview, and Marshall, in or near the oil field, are very active and growing centers. Texarkana, on the Texas-Arkansas State line in the northeast corner of the unit, has long been a center of forest industries. Convenient access can be had to the larger cities of Dallas and Fort Worth on the west, and to Shreveport, La., on the east, as main highways and railroads cross the unit and connect these urban centers.

The surface topography is gently undulating to moderately hilly, with a general southeast slope. Elevations range from 200 to 600 feet above sea level, some of the highest land occurring in Anderson, Cherokee, Smith, and Rusk Counties. The northern part of the unit is drained by the Red River and its tributaries, while the remainder is largely in the drainage basin of the Sabine. All the main streams flow southward or southeastward. Moderate sheet erosion and occasional or frequent gullies occur throughout the unit except in the stream bottoms and on two areas in Panola and Red River Counties that have only slight sheet erosion (Reconnaissance Erosion Survey, Soil Conservation Service, 1934).

Seven main railroad systems, with several secondary roads, provide adequate rail transportation throughout the unit and to outside points. Paved highways are numerous and well distributed. Five Federal highways cross the unit from east to west and two from north to south. Practically all the State highways are paved and most of the county roads are passable for motor vehicles even in wet weather. Forested areas hitherto unavailable to motor transport have been tapped by Civilian Conservation Corps truck trails, so that not many areas now exist that are more than a few miles from a road.

The discovery of oil has caused rapid changes in the population since the census of 1930. At that time the total population was 522,000, but it is probably nearer 650,000 at present. In 1930 nearly 80 percent of the people lived outside of urban centers, and even though these urban centers have grown

rapidly, it is possible that this proportion has increased, since many of the oil-field workers live in rural homes and scattered communities. Agriculture furnished employment to 64 percent of the working population in 1930, while forest industries furnished year-long employment to only 3 percent. According to the last Census of Agriculture, farmers secured 1,912,000 man-days of employment away from their farms in 1934; this is equivalent to 24 days for each farm operator. Much of this labor was expended in the oil fields and the forest industries. The great need for employment by all classes of people in the unit is evident from the Unemployment Census of November 1937, according to which 31,800 were totally unemployed, 6,500 were engaged in emergency relief work, and 18,200 were partly employed but wanted more work.

Land held in small farms is the leading type of land use. According to the 1935 Census, there were 79,000 farms in the unit containing 6,165,000 acres, or 72 percent of the land area. These farms averaged 78 acres each, 26 of which were wooded. The total acreage in these farm woodlands amounts to 2,068,000 acres, or 52 percent of all the forest lands. The number of farms decreased slightly between 1930 and 1935, but the total acreage in farm ownership increased by about 770,000 acres. Practically all of this increase is wooded or pasture land, as the area available for crops remained about as in 1930. The amount of idle cropland increased from 242,000 acres in 1924 to 512,000 acres in 1934, owing in part to the tendency of farmers in, or adjacent to, the oil field to depend upon oil leases and royalties for income rather than tillage of the soil, and in part to the Federal crop-control programs of recent years.

Cotton is the principal crop. Between 1924 and 1937 the cotton acreage was reduced by 36 percent, or 576,000 acres. This shrinkage in cotton acreage must seriously affect the economic life both of the rural people and of the region as a whole, since it has resulted in a labor loss equivalent to nearly 5 million man-days of employment. This shrinkage in employment, which has probably affected between 40,000 and 50,000 people, is undoubtedly reflected in the unemployment data given above.

Although cotton growing has decreased the corn acreage increased nearly 100,000 acres between 1929 and 1934. The growing of tomatoes, sweet and Irish potatoes, and watermelons for market has increased materially; about 65,000 acres of these crops were grown in 1934. Specialized crops, such as the commercial production of rose bushes around Tyler, are important in a few localities. The tomato industry, centering in Cherokee and Smith Counties, is a source of cash income to part of the farm population, and also utilizes a part of the production of the 17 veneer and basket plants in the unit.

The results of a classification by the Survey of the land area of the unit according to actual land use are given in table 1. A large part of the 700,000 acres of idle or abandoned land should be used for timber production. Since most of this acreage is in small tracts, often contiguous to forest stands, natural seeding will restock a part of the land. Artificial planting will be necessary on the rest. Fire protection is essential in either case.

Table 1. - Land area classified according to land use, 1935

Land use	Area		Percent of total area	
	- - - - - Acres - - - - -			
Forest:				
Productive	3,943,100		45.7	
Nonproductive	3,100		.1	
Total forest		3,946,200		45.8
Nonforest:				
Agricultural:				
In cultivation:				
Old cropland	2,885,000		33.4	
New cropland	102,300		1.2	
Out of cultivation:				
Idle	532,500		6.2	
Abandoned	171,000		2.0	
Pasture	770,700		8.9	
Total agricultural	4,461,500		51.7	
Other nonforest	214,400		2.5	
Total nonforest areas		4,675,900		54.2
Total forest and nonforest		8,622,100		100.0

Description of the Forest

The forests of northeast Texas are largely second growth, typically found in small tracts intermingled with cultivated land. Of the forest area 78 percent is in the rolling uplands, 10 percent in swamps and small stream bottoms, and 12 percent in the main river bottoms. Shortleaf and loblolly pines mixed with hardwoods form the characteristic forest of the uplands, while red gum, red and white oaks, and various other hardwoods occur in the river bottoms. The two pine species are well distributed throughout the upland pine area, although shortleaf is much more abundant, particularly upon the higher hills and ridges. Along the western and northern edges of the unit, the pine-hardwood stands are replaced by nearly pure hardwoods, chiefly scrubby post oak (fig. 3). The river-bottom hardwoods are found mainly in the bottoms of the Red, Sulphur, Sabine, Angelina, Neches, and Trinity Rivers.

Ninety percent of the total forest area is stocked with second-growth timber (table 2), two-thirds of which is of sawlog size. The clear-cut area is negligible. The old-growth stands, which occupy only 10 percent of the forest area, are largely confined to the hardwood types. Less than 100,000 acres of old-growth pine remains, and most of this is in small, widely scattered tracts, often only a few acres in extent. Some of the larger blocks are located in Panola County along the east bank of the Sabine River, in Shelby County, and in Anderson County along the Neches River.

Table 2. - Forest area classified according to forest condition and forest type-group, 1935

Forest condition	Pine	Pine-hardwoods	Upland hardwoods	Bottom-land hardwoods	Total all types	Proportion of total
	Acres					Percent
Old growth:						
Uncut	33,600	21,900	44,500	85,900	185,900	4.7
Partly cut	26,500	17,200	68,700	93,700	206,100	5.2
Total	60,100	39,100	113,200	179,600	392,000	9.9
Second growth:						
Sawlog size:						
Uncut	762,100	273,300	118,700	170,200	1,324,300	33.6
Partly cut	418,500	243,600	107,000	117,900	887,000	22.5
Under sawlog size	224,100	282,700	509,800	178,000	1,194,600	30.3
Reproduction	17,200	22,600	87,500	11,700	139,000	3.5
Total	1,421,900	822,200	823,000	477,800	3,544,900	89.9
Clear-cut	2,300	1,500	1,600	800	6,200	.2
Total all conditions	1,484,300	862,800	937,800	658,200	3,943,100	100.0
Percent of total forest area	37.6	21.9	23.8	16.7	100.0	

Figure 1 shows the species composition of the four type-groups into which the forest stands were classified. In this figure the net cubic-foot volumes in each of the four species-groups—(1) pines, (2) gums and other pulping hardwoods, (3) oaks including scrub oak, (4) hickories, elms, etc.—are expressed as a percentage of the total net cubic-foot volume in the type-group. Conspicuous is the high proportion of pine, three-fourths of which is shortleaf, in the "pure" pine type-group. In the upland hardwoods type-group, nearly two-thirds of the oaks are post and scrub species of rather inferior quality, while hickory is more abundant here than in any other type-group. The bottom-land hardwoods have more than half their volume in red gum and in red and white oaks. Ash, although making up only 3 percent of the bottom-land hardwoods is most prevalent in this type-group.

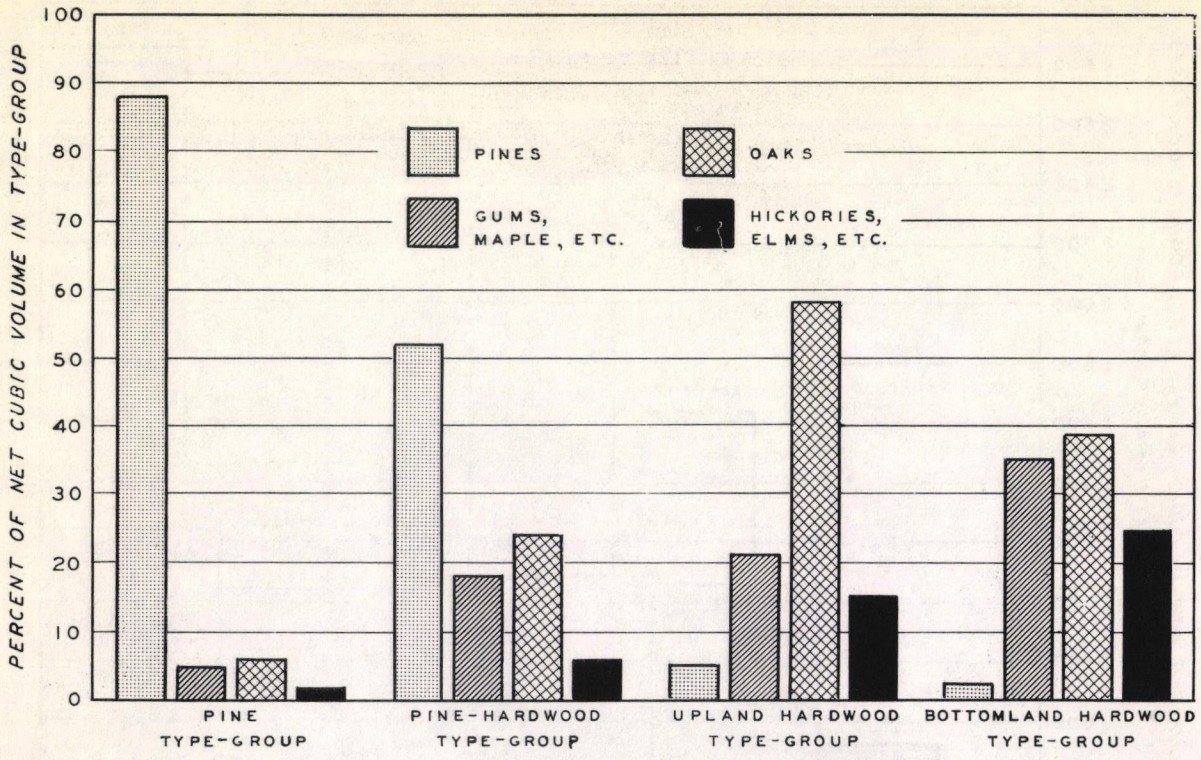


FIGURE 1 - SPECIES COMPOSITION OF FOREST TYPE-GROUPS.

The approximate age-class and volume distribution of the present pine and pine-hardwood forest is compared in figure 2 with that of a theoretical ideal forest managed on a rotation of 70 years. The area represented is the 2,347,100 acres at present stocked to the type of forest that occupies 60 percent of the total forest area. The forest under management is divided into 7 equal areas, each containing 335,300 acres and supporting one 10-year age-class. The occurrence of age-classes in the present forest is also plotted; and reference to figure 2 shows that the areas occupied by the respective age-classes are far from regular, varying from 2 percent of the total area in the 0- to 10-year age-class to 22 percent in the 41- to 50-year age-class. The per-acre volumes of the managed forest are based upon the best stocked 10 percent of the uncut stands of weighted-average sites in the pine and pine-hardwood types, while the volumes of the present forest are averages of all the stands in a specific age-class.

The figure reveals several characteristics of the present pine and pine-hardwood forest among which are that (1) stocking is much less than the land is capable of supporting, as the present forest contains only 52 percent of the volume of the managed stands; and that (2) while the distribution of age-classes by area does not agree with that of the managed forest, it is not unfavorable for sustained yield provided the age-classes are utilized in the order of their maturity during the period of the rotation.

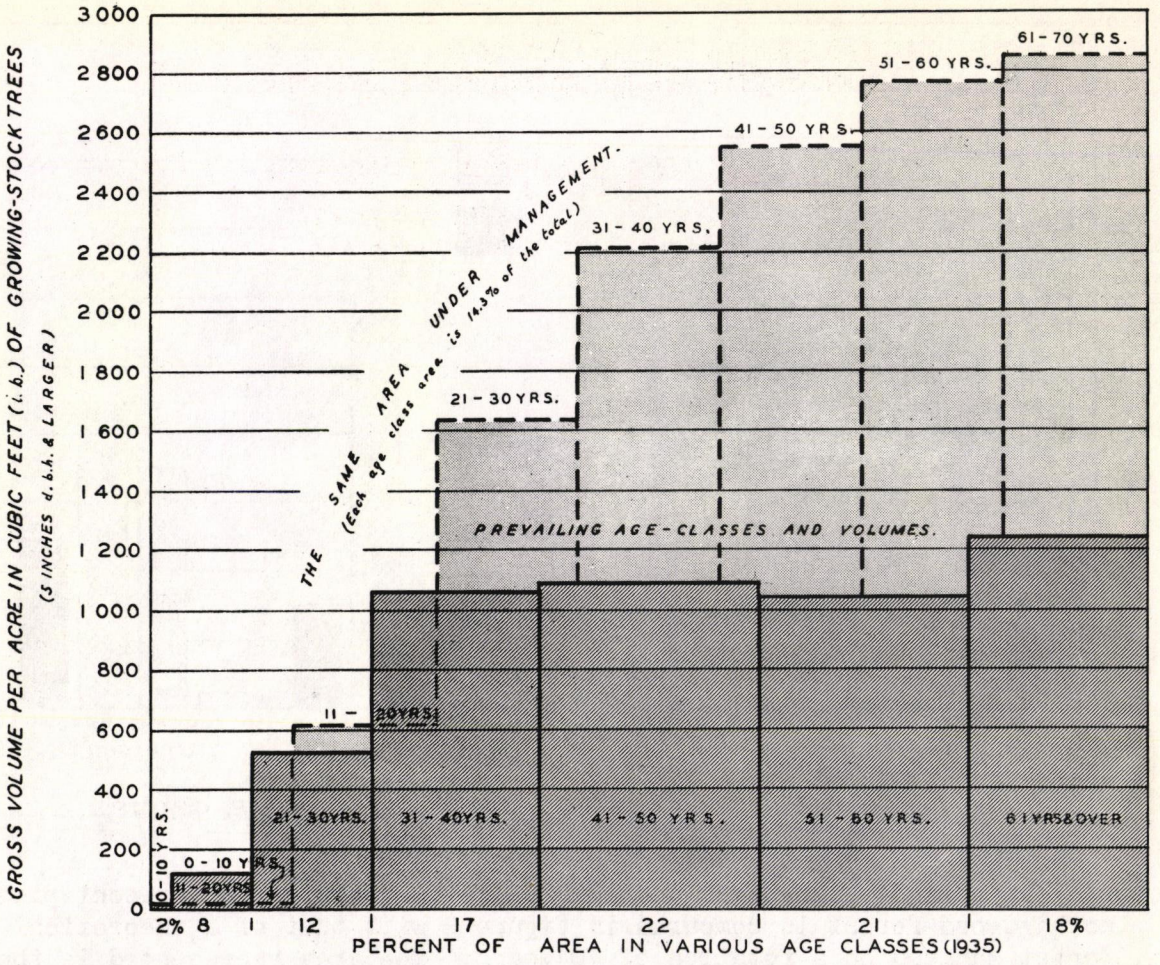


FIGURE 2 - PREVAILING AGE-CLASS AND VOLUME DISTRIBUTION COMPARED WITH THAT ON THE SAME AREA UNDER MANAGEMENT (BASED ON PINE AND PINE-HARDWOOD TYPE AREAS OF 2,347,100 ACRES).

While no comparable calculation for the upland hardwood and bottom-land hardwood type-groups has been attempted, it may be said with confidence that the stocking in these type-groups is far below the attainable density and the proportionate volume in large trees is less than it should be to obtain the full benefit of forest management.

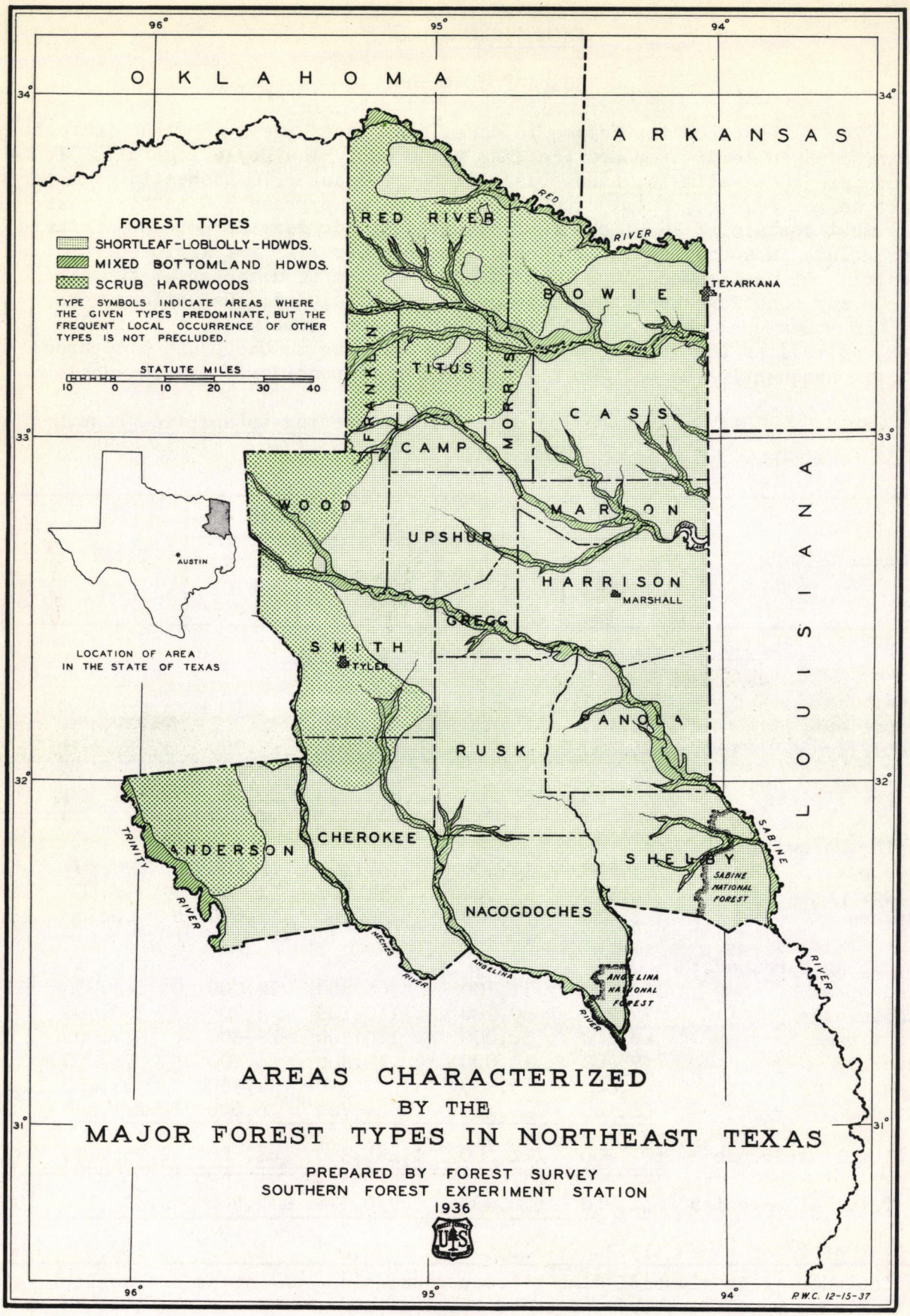


FIGURE 8 - FOREST TYPE MAP.

Volume Estimates

Board-foot volume

The estimate of the volume in sound saw-timber trees is given in table 3, expressed in terms of board feet, as measured by the Doyle log rule. To be included in this estimate, hardwoods must be at least 13.0 inches in diameter at breast height (d.b.h.) outside bark, and pines and cypress 9.0 inches. Also all trees must contain at least one 12-foot butt log, or have 50 percent of their gross volume in sound material. Top diameters vary with the limits of usable material, but no hardwood logs less than 8.5 inches in diameter at the small end nor any pine logs less than 5.5 inches were included. Deductions were made for woods cull, such as rot, fire-scar, crook, limbiness, and similar defects, as well as for loss in sawing at the mill due to sweep and hidden defects; consequently the volumes given here can be considered net log scale.

Table 3. - Net volume (Doyle) classified according to species-group and forest condition, 1935

Species-group	Old growth		Second growth		Total	Percent of total
	Uncut	Partly cut	Sawlog size	Under sawlog size 1/		
	Thousand board feet					
Pines:						
Shortleaf	167,500	113,000	1,744,500	34,300	2,059,300	37.5
Loblolly 2/	174,200	41,200	910,500	13,700	1,139,600	20.8
Total pines	341,700	154,200	2,655,000	48,000	3,198,900	58.3
Pulping hardwoods:						
Red gum	83,500	46,400	357,400	12,200	499,500	9.1
Black gum	24,900	17,900	51,600	2,700	97,100	1.8
Others 3/	8,500	18,700	38,100	1,600	66,900	1.2
Nonpulping hardwoods:						
Red oaks	154,800	111,100	365,800	12,000	643,700	11.7
White oaks	77,200	80,900	140,100	2,700	300,900	5.5
Post oak	68,800	80,000	180,300	18,800	347,900	6.3
Hickory	7,200	11,000	49,800	6,200	74,200	1.4
Ash	8,000	9,300	23,500	2,300	43,100	.8
Others	68,100	49,100	88,700	6,000	211,900	3.9
Total hardwoods	501,000	424,400	1,295,300	64,500	2,285,200	41.7
Total all species	842,700	578,600	3,950,300	112,500	5,484,100	100.0
Percent of total	15.4	10.5	72.0	2.1	100.0	

1/ Includes areas classified as reproduction; clear-cut areas are negligible.
2/ Includes 65 million board feet of longleaf pine.
3/ Includes 22 million board feet of cypress.

The total board-foot volume by the Doyle rule is nearly 5½ billion feet. This volume is shown by species-groups and forest conditions in table 3. Accessibility is not a limiting factor in the utilization of this volume, as shown by the fact that 95 percent (table 2) of the forest area has been logged over at least once, and the increasing use of truck transportation makes it even possible in many areas to log for individual selected trees.

Fifty-eight percent of the total volume occurs in the pine species, with the volume of shortleaf almost twice that of loblolly. In the hardwoods, which account for nearly 42 percent of the total volume, red oaks and red gum are most common. The nearly 600 million board feet of red and black gum form the chief support of the active crate and basket industry in the unit—an industry which utilizes nearly 20 million board feet of these species each year.

The volume has been shown in table 3 by the Doyle log rule, because this rule is in general use throughout the South; but since this rule materially underestimates the volume of small trees, which make up a large proportion of the stand in this unit, a more accurate expression of the recoverable volume is obtained by using the International ¼-inch rule. The latter rule therefore, is used in table 4, where the volumes given very closely approximate green lumber tally. A comparison of volumes in tables 3 and 4 shows that the Doyle rule underestimates lumber tally by 25 percent in the old-growth conditions, while in the second-growth conditions, made up chiefly of smaller trees, the under-estimate is 41 percent.

Table 4. - Net volume, lumber tally, classified according to species-group and forest condition, 1935

Forest condition	Pines	Red and black gums, etc.	Red and white oaks, etc.	Total
	Thousand board feet (green lumber tally)			
Old growth:				
Uncut	483,300	152,200	481,300	1,116,800
Partly cut	233,700	111,800	436,500	782,000
Second growth:				
Sawlog size	4,895,000	652,100	1,169,500	6,716,600
Under sawlog size 1/	107,800	26,800	71,000	205,600
Total all conditions	5,719,800	942,900	2,158,300	8,821,000

1/ Includes reproduction; clear-cut acreage is negligible.

Although old-growth stands occupy only 10 percent of the forest area, they contain 22 percent of the total saw-timber volume (lumber tally), or nearly 2 billion board feet. Only 13 percent of the total pine volume is in old-growth stands, as compared with 38 percent of the hardwood volume. The

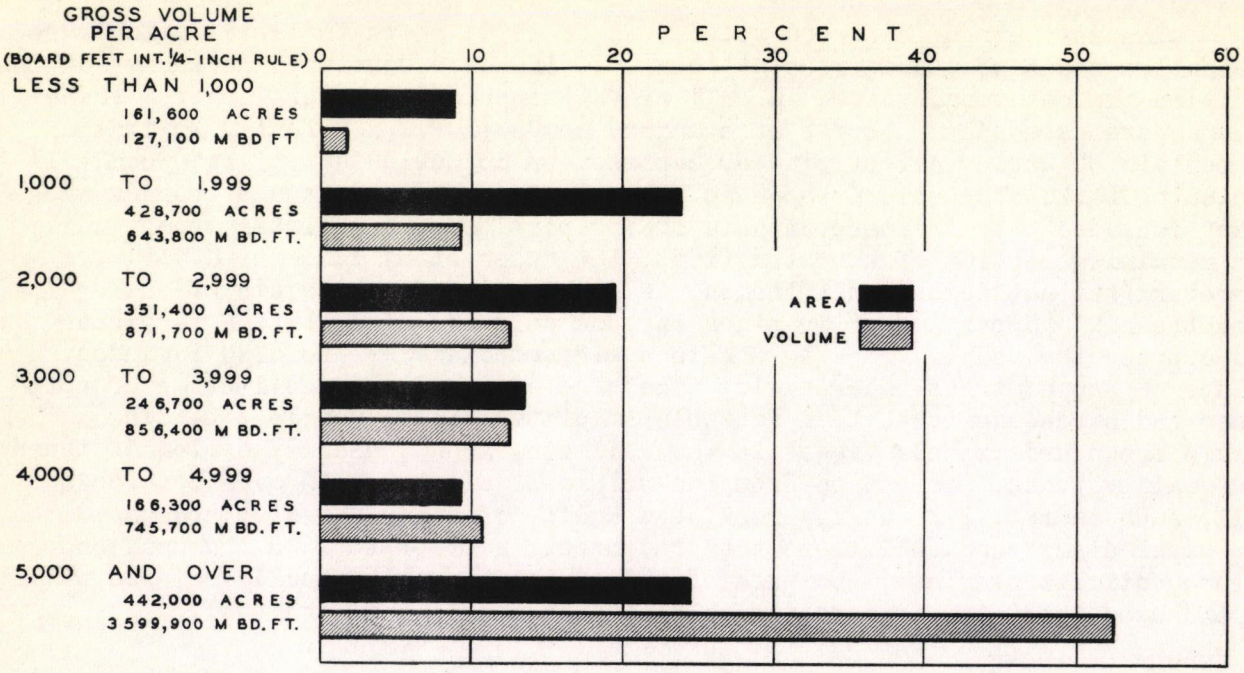
average volume per acre[1/] in the old-growth uncut condition of the pure pine types is 10,900 board feet, of which 10,600 is pine. The similar condition in the upland hardwood types averages 3,000 board feet per acre, while in the bottom-land hardwood types this condition averages 5,200 feet, each of these types having less than 200 feet of pine per acre.

The second-growth pine and pine-hardwood stands which occupy 57 percent of the forest area, contain 65 percent of the saw-timber volume. Uncut stands of the pure pine types average 4,000 feet per acre, and of the pine-hardwood types 3,300 board feet. The second-growth hardwood stands occupy 33 percent of the forest area but contain only 13 percent of the total saw-timber volume. In the upland hardwoods, the uncut stands average 1,700 feet per acre, while similar stands in the bottom-land hardwoods average 2,700 feet.

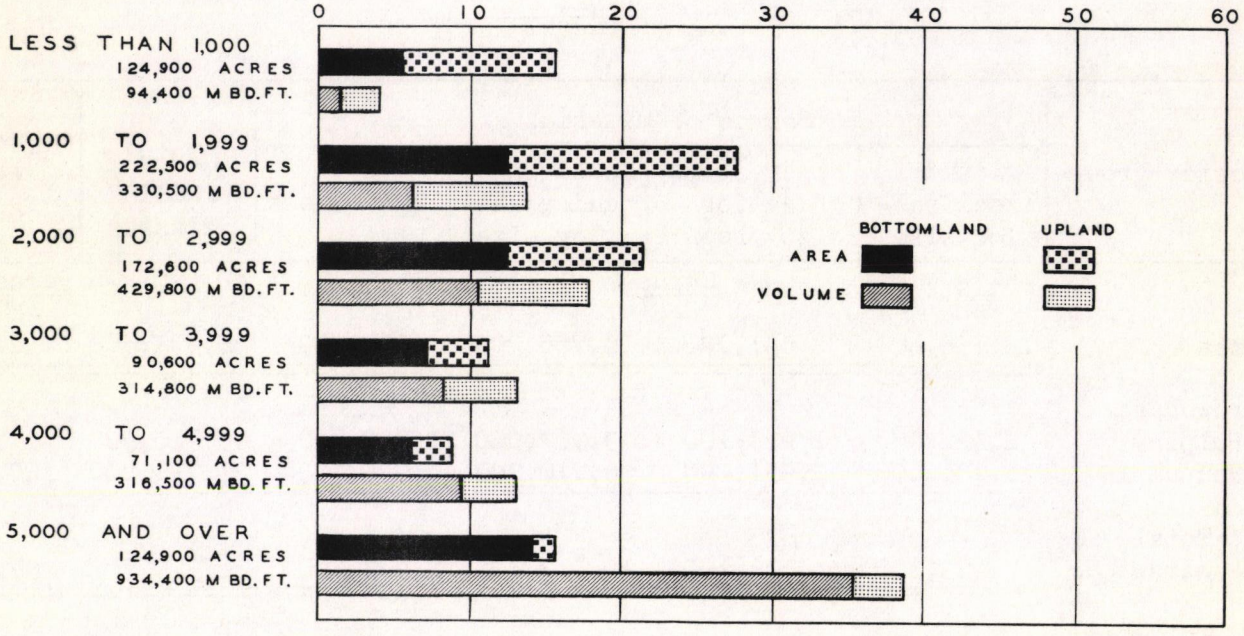
In figure 4 is shown the area and volume of the sawlog-size conditions grouped according to gross volume-per-acre classes. The portion of the figure designated as 4-A is based upon the pine and pine-hardwood types, which occur on 1,796,700 acres, or 46 percent of the forest land, and contain 73 percent of the total board-foot volume. Stands having at least 2,000 board feet per acre are found on two-thirds of the area and contain 89 percent of the volume. More than half the volume is in stands of at least 5,000 feet per acre, occupying only 25 percent of the area in these types.

The sawlog-size stands in the bottom-land and upland hardwood types represented in figure 4-B have a combined area of 806,600 acres, or 20 percent of the forest land; their volume is 25 percent of the total board-foot stand. Fifty-seven percent of the area is stocked with at least 2,000 board feet per acre, containing 82 percent of the volume in these types. In the bottom-land hardwood types, however, 69 percent of the area is stocked with stands of at least 2,000 board feet per acre, while in the upland hardwood types only 40 percent of the area is stocked this heavily.

1/ "Volumes on an average acre in the various units of the Pine-Hardwood Region west of the Mississippi," Forest Survey Release #26, July 12, 1937, Southern Forest Exp. Sta., New Orleans, La.



A - PINE AND PINE-HARDWOOD TYPES



B - BOTTOMLAND AND UPLAND HARDWOOD TYPES

FIGURE 4 - PROPORTIONAL AREA AND VOLUME OF THE SAWLOG-SIZE CONDITIONS, CLASSIFIED ACCORDING TO VOLUME OF SAW TIMBER PER ACRE.

Cordwood volume

The estimate of cordwood volume, as of 1935, shown in table 5, includes the entire stand of sound trees at least 5.0 inches d.b.h. outside bark, and in addition the net sound volume in cull trees 5 inches d.b.h. or larger. These volumes are expressed in terms of standard cords (4 x 4 x 8 feet), estimated to contain 90 cubic feet of pine or cypress, or 80 cubic feet of hardwood, all including bark. The volume shown in table 5 in the column "sound trees sawlog size" includes only the merchantable sawlog portion of saw-timber trees, while the remaining portion of the stem (i.e., the upper stem) taken to a variable diameter (but not less than 4 inches) is given under "upper stems of sawlog-size trees." "Upper stems" in pines include only the stem, but in hardwoods and cypress the usable limbs to a 4-inch minimum diameter are also included. Volume of "sound trees under sawlog size" includes only the full stems of both pines and hardwoods taken to a variable (minimum 4-inch) usable top. The volume shown under "cull trees" is the estimated sound, usable portion of these low-quality trees. Deduction from the volume of all trees is made for woods cull, such as rot, fire-scar, crook, bad knots, or other defects. Volume data on "upper stems" and cull trees are presented, in order to make the cordwood volume estimate complete; how much of this material will actually be used will depend upon the future demand for pulpwood, chemical wood, and fuel.

Table 5. - Net volume of all sound material, expressed in cords of wood with bark, 1935

Species-group	Source of material				Total all classes	Proportion of total
	Sound trees sawlog size	Upper stems of sawlog-size trees	Sound trees under sawlog size	Cull trees		
	Cords					Percent
Pines	13,188,600	2,631,700	6,766,200	405,000	22,991,500	42.3
Hardwoods:						
Pulping	2,422,000	1,228,100	3,903,000	1,967,800	9,520,900	17.5
Nonpulping	5,201,600	2,951,000	6,710,700	6,935,500 1/	21,798,800	40.2
Total hardwoods	7,623,600	4,179,100	10,613,700	8,903,300	31,319,700	57.7
Total all species	20,812,200	6,810,800	17,379,900	9,308,300	54,311,200	100.0
Percent of total	38.4	12.5	32.0	17.1	100.0	

1/ Includes scrub oak.

Of the pine cordwood volume 72 percent is shortleaf, and practically all of the remainder is loblolly, with pines under 9.0 inches d.b.h. containing 29 percent of the total pine volume. The pulping hardwood volume is chiefly red gum, although such species as black gum, maple, willow, and cypress are included. In these pulping hardwoods, 41 percent of the cordwood volume is in trees below sawlog size. In the nonpulping hardwoods, chiefly various species of oaks, nearly half the cordwood volume shown is in scrub oaks, cull trees, and in the upper stems of saw-timber trees, leaving about 12 million cords in the merchantable boles of sound trees.

In figure 5 the cordwood volume of sound trees is classified according to species-group and diameter-class. Sound-tree volume as used here includes the full stem of under-sawlog-size pines and hardwoods as described previously, the full stem of merchantable pines to a variable (minimum 4-inch) top, and the saw-timber portion of sawlog-size hardwoods. The volume in cull trees, scrub oaks, and tops and limbs of merchantable hardwoods is not included.

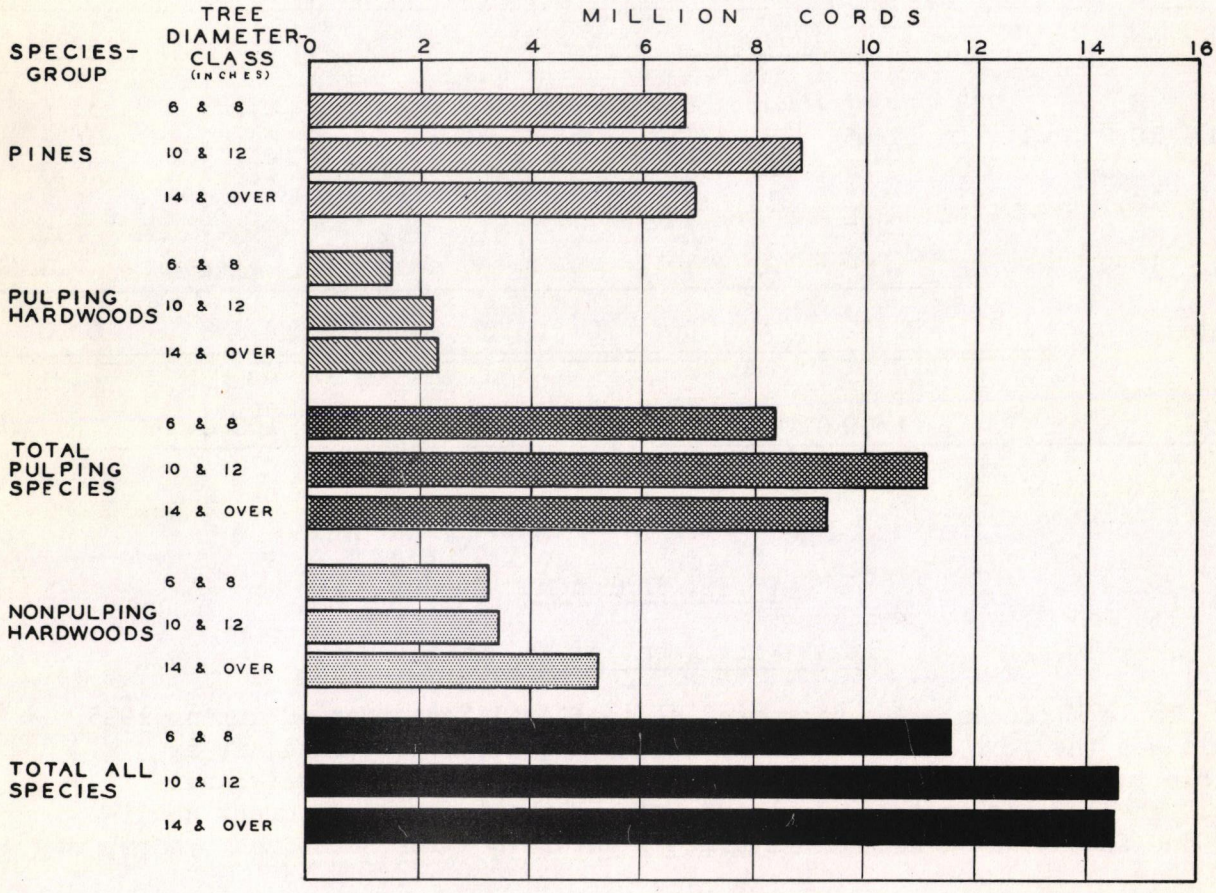


FIGURE 5 - CORDWOOD VOLUMES OF PULPING AND NONPULPING SPECIES.

Pine poles and piles

The pine trees suitable for poles or piles occur singly or in scattered groups throughout the forest. Table 6 gives the timber cruisers' estimate of the number of pole or pile trees in the unit, classified according to length and diameter (outside bark). As it is difficult to classify trees while they are standing, it is probable that the actual number of poles or piles recoverable from the forest will vary somewhat from the total shown in the table. Although these totals are probably low, owing to the conservatism of the field crews, the proportions of trees of the various length and diameter are believed to be fairly accurate.

Table 6. - Total number of pine poles or piles, classified according to length and diameter, 1935

D.B.H. of trees (outside bark)	Pole or pile length (feet)							Total	Proportion of total
	20	25	30	35	40	45	50 or over		
Inches	Thousand pieces								Percent
7.0 - 8.9	2,758	1,083	606	81	-	-	-	4,528	35.4
9.0 - 10.9	1,571	1,265	871	334	306	38	-	4,385	34.2
11.0 - 12.9	518	725	662	331	219	106	44	2,605	20.3
13.0 - 14.9	91	222	315	153	128	46	38	993	7.8
15.0 - 16.9	3	37	94	47	44	16	12	253	2.0
17.0 - 18.9	-	-	22	10	9	3	-	44	.3
Total	4,941	3,332	2,570	956	706	209	94	12,808	100.0
Percent of total	38.6	26.0	20.1	7.5	5.5	1.6	0.7	100.0	

Forest Increment

Forest increment of the unit

Table 7 presents the increment of the total forest stand during 1935. As this was the year in which the growing stock was inventoried, it is possible to determine with some accuracy the increment by forest conditions. The changes in the volume and area of the individual forest conditions due to cutting cannot be accurately determined for subsequent years,

for which increment can be expressed only in totals for all conditions combined. The increment shown in table 7 includes the volume increase of all trees that remained in the stand during the year, as well as the increment accruing for a portion of the year on the trees that were cut. Volume lost through mortality and other natural losses is deducted.

Table 7. - Forest increment in board feet and cubic feet in the various forest conditions, 1935

Forest condition	Saw-timber material			All material		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	---Thousand board feet---			Thousand cubic feet (i.b.)		
Old growth	17,100	40,500	57,600	3,470	5,660	9,130
Second growth:						
Sawlog size	345,600	87,200	432,800	76,220	22,810	99,030
Under sawlog size	46,400	16,400	62,800	16,960	13,270	30,230
Reproduction and clear-cut	100	200	300	40	70	110
Total all conditions	409,200	144,300	553,500	96,690	41,810	138,500

The increment rate of the pine board-foot growing stock was 7.2 percent in 1935. This is a noteworthy increase for a stand that extends over 4 million acres and that has been subject to repeated burning. Four percent of the pine saw-timber increment occurred in old-growth stands, 85 percent in sawlog-size second growth, and 11 percent in young stands not yet of sawlog size. The hardwood growing stock increased by only 4.7 percent. Old-growth stands produced 28 percent of the saw-timber increment in this species-group, sawlog-size second growth 60 percent, and under-sawlog-size stands 12 percent. Although the growing stock was increased through increment by more than a half billion board feet during 1935, nearly as great an amount was removed for utilization with the result that there was little change in the stand volume in that year.

The increment for 1935 is expressed in standard cords (4 x 4 x 8 ft.) in table 8. This material is not in addition to that given in table 7 but is identical with the cubic-foot volume there given, except that the volume in table 8 includes bark. The values in this table, therefore, express the volume in the form of measurement commonly used in the pulpwood industry throughout the South.

Table 8.- Forest increment in 1935 in the various forest conditions, expressed in cords of wood with bark

Forest condition	Pine	Hardwood	Total
		Cords	
Old growth	44,500	83,000	127,500
Second growth:			
Sawlog size	988,200	349,300	1,337,500
Under sawlog size	227,000	209,100	436,100
Reproduction and clear-cut	600	1,100	1,700
Total all conditions	1,260,300	642,500	1,902,800

In table 9 the increment in board feet and cubic feet is shown for the 3 years that have elapsed since the inventory was taken. Each year the growing stock, i.e., the forest capital, was increased by the net increment of the previous season and was reduced by the amount of utilization drain, so that the increments shown are based upon the growing stock that existed there each year. Although the board-foot increment has remained relatively constant, there has been a gradual increase in the cubic-foot increment, owing in part to the large influx of small trees into the measurable sizes (5 inches d.b.h. and larger). The values for 1937 are used in the comparison of increment and drain given in the latter part of this report.

Table 9.-Forest increment in board feet and cubic feet in 1935, 1936, and 1937

Year	Saw-timber material			All material		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	Thousand board feet			Thousand cubic feet (i.b.)		
1935	409,200	144,300	553,500	96,690	41,810	138,500
1936	408,000	143,000	551,000	99,820	42,610	142,430
1937	408,900	144,600	553,500	100,540	42,810	143,350

Increment per acre of uncut stands

The estimated increment per acre of the various forest conditions, all types combined, is presented in table 10. The growing stock upon which this increment is based is that of the 1935 inventory. No deductions from the stand were made for timber removed during the year. The increment given in board feet occurred only on saw-timber material, while cubic-foot and cordwood volumes include the increment on the full usable stem of all pines and all under-sawlog-size hardwoods above 5.0 inches d.b.h., and on the saw-timber portion of sawlog-size hardwoods. Increment in cull trees or in limbs of any trees is not included. Cordwood volumes include bark, but cubic-foot volumes are for wood only.

Table 10. - Average increment per acre in the various forest conditions undisturbed by cutting in 1935

Forest condition	Pine component			Hardwood component			Total per acre		
	Bd.Ft.	Cu.Ft.	Cords	Bd.Ft.	Cu.Ft.	Cords	Bd.Ft.	Cu.Ft.	Cords
Old growth:									
Uncut	60	11.5	.15	116	15.1	.22	176	26.6	.37
Partly cut	31	6.8	.09	94	14.1	.20	125	20.9	.29
Second growth:									
Sawlog size:									
Uncut	192	43.7	.57	40	11.3	.17	232	55.0	.74
Partly cut	117	23.1	.30	43	9.6	.15	160	32.7	.45
Under sawlog size	41	14.5	.19	16	11.3	.18	57	25.8	.37
Reproduction and clear-cut	1	.3	Neg.	1	.5	.01	2	.8	.01
Weighted averages	108	25.2	.33	38	10.8	.16	146	36.0	.49

Sawmills

In 1937 there were at least 330 sawmills operating in the unit (table 11). Only five of these mills had a capacity of more than 40 M board feet per day. Although small portable mills (1 to 19 M capacity) are most numerous (fig. 6), nearly half of all the lumber produced in 1937 was cut by the 24 mills having a capacity of 20 to 39 M board feet per day. The total lumber production amounted to 331 million board feet, of which 289 million was pine and 42 million was hardwoods. Logs cut within the unit furnished 292 million board feet of the total, while logs imported into the unit for manufacture into lumber furnished 39 million board feet. Logs shipped to sawmills outside the unit amounted to 61 million board feet.

The Survey found about 300 sawmills having a board-foot capacity of less than 20 M feet per day. Nearly 100 of these were located in Smith,

Anderson, Cherokee, and Nacogdoches Counties in the southwest part of the unit. Also a concentration of about 50 small mills was found in Red River and Bowie Counties, in the extreme northern part of the unit. The majority of these small mills are extremely mobile, moving frequently from one tract of timber to another. About 70 percent of them are powered by tractors or old automobile engines, while 30 percent use steam power. The cut of individual mills varies greatly, but the average for all mills in this class was 364,000 board feet during 1937. Their total cut was 109.6 million board feet, equal to 33 percent of all the lumber produced in the unit.

Table 11. - Number of sawmills and extent of employment, classified according to size of mill, 1937

Daily (10 hrs.) rated capacity 1/	Mills 2/			Employment		
	Pine	Hardwood	Total	In woods	In mill	Total
- - - M bd. ft. - - -	- - - - Number - - - -			- - - Thousand man-days - - -		
Under 20	No division		301	95	179	274
20 to 39	22	2	24	131	268	399
40 to 79	2	1	3	80	82	162
80 and over	2	-	2	77	87	164
Total			330	383	616	999

1/ The rated capacity indicates size of mill rather than actual average daily production.

2/ The data given here on the number of mills in the smallest class are estimates based upon all available records supplemented by a field check.

In 1937 there were 24 sawmills having a capacity of 20 to 39 M board feet per day. Two of these were hardwood mills and the rest cut chiefly pine. Their total production was 139.4 million board feet, amounting to 42 percent of the lumber production of the unit. About 10 percent of the pine lumber and practically all the hardwood was sold unfinished. These mills secured nearly a quarter of their requirements from outside the unit. Mills of this size are relatively stable, generally being in some town where shipping facilities are convenient. Most of them buy logs, although some of them secure timber from their own land. With the increasing use of truck transportation, this size of mill is assuming an increasingly important place in the sawmill industry, since it can practice close utilization and can manufacture quality lumber with a plant cost per thousand board feet daily capacity less than half of that of large mills.

There were only 5 mills with a capacity of more than 40 M board feet per day. Their total production was 82 million board feet or 25 percent of the lumber cut in the unit. Seven percent of the pine lumber was sold rough and 74 percent of the hardwood. Over 90 percent of their log requirements came from within the unit, and the rest from southwest Arkansas and southeast Texas. Old-growth stands furnished about 40 percent of the pine volume and 92 percent of the hardwood. At the rate of utilization in 1935, there was enough old-growth pine timber to last 8 or 10 years, but since second-growth logs are often purchased to supplement the cut, it is possible that the supply of old growth will last for a much longer period.

Other forest industries

There is an active veneer industry in this unit. During 1937 there were 16 plants engaged in producing veneer (table 12), with most of them manufacturing the veneer directly into baskets, crates, boxes, and tomato lugs. On the basis of past production, it is estimated that there were produced during the year about 15 million individual items, a large proportion of which was used in Texas and neighboring States. The 16 plants consumed slightly over 23 million board feet of wood during 1937, of which 9 percent was pine, 72 percent red gum, 8 percent black gum, 9 percent cottonwood, and 2 percent other species. Seventy-three percent of this wood came from within the unit, 20 percent from southwest Arkansas, and practically all of the remainder from areas in Texas lying south and west of the unit. All of the wood is purchased delivered at the mill, usually in bolts rather than in log lengths, as the operators believe that better utilization is obtained when the bolts are cut in the woods.

Shingle mills are numerous in this part of Texas, especially in Cass, Harrison, Morris, Marion, Shelby, and Upshur Counties. In 1937 there were at least 50 of these small plants, producing shingles chiefly from second-growth pine. They secure all of this material locally, moving from place to place as additional timber is needed. Individual mills seldom use more than 25 M board feet per year.

Other plants manufacturing wood products include one stave and heading mill and one handle plant. Red and white oaks and gums are used for cooperage and ash and hickory for handles. These two plants have been established in one locality for many years.

Contributing far more employment and handling a much larger volume of forest products in the unit than the 52 miscellaneous plants described above, are 3 treating plants, which purchase large quantities of lumber, cross ties, poles, piles, and posts for preservative treatment and also custom-treat a large amount of material, mostly pine, secured throughout east Texas as well as in Arkansas, Louisiana, and Mississippi.

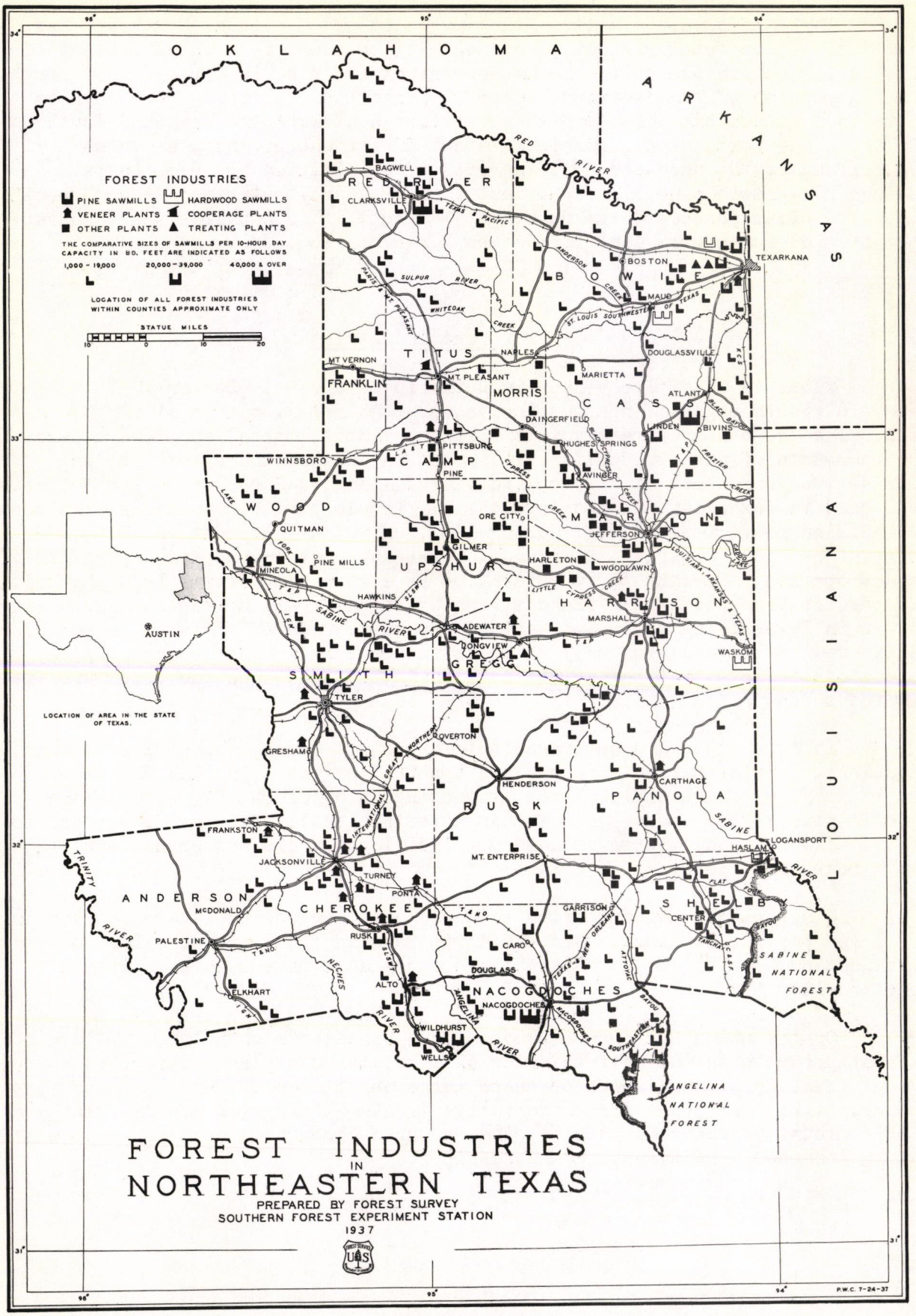


FIGURE-6 FOREST INDUSTRIES MAP.

Employment

The total employment furnished by the forest industries in 1937 amounted to 2,885,000 man-days. Sixty-seven percent of this work was in the woods and 33 percent in the mills and plants. The production of fuel wood and fence posts required the expenditure of 45 percent of the total labor, but very little of this work yielded a direct cash return, as most of these materials were produced for home consumption. Employment yielding a cash income amounted to 1,578,000 man-days, of which 63 percent was provided by the lumber industry. Based on the requirements of the present forest industries, it is probable that forest employment will approximate 3,000,000 man-days per year for the next 10 years, equivalent to 12,000 man-years if 250 days is considered a full year.

Table 12. - Production and employment data, 1937

Kind of plant or commodity	Number of plants	Cut in woods	Produced or used by plants	Thousand man-days of employment		
				In woods	In plants	Total
		--- M bd. ft. ----				
Sawmills	330	353,300	331,000	383	616	999
Veneer	17 1/	19,100	23,100	31	206	237
		M cu. ft.				
Treating plants	3	-	8,620	-	100	100
		M pieces				
Cross ties	-	1,329	-	175	-	175
Poles and piles	-	173	-	23	-	23
Fence posts	-	6,374	-	101	-	101
		Cords				
Pulpwood	-	11,700	-	12	-	12
Fuel wood	-	1,118,900	-	1,206	-	1,206
Miscellaneous 2/	52	12,100	14,100	12	20	32
Total	402			1,943	942	2,885

1/ One plant idle during 1937.
2/ Includes 1 cooperage plant, 1 handle plant, and 50 shingle mills.

Utilization Drain

During 1937 the wood requirements of the various forest industries and local users amounted to 645.6 million board feet from trees of sawlog size, or a total of 145.4 million cubic feet, when the trees below sawlog size are included. This was the drain upon the sound-tree growing stock only. About 17 million cubic feet of additional material was taken from cull trees and was used chiefly for fuel wood. Table 13 shows the drain upon the sound trees, by

pine and hardwood species-groups, distributed according to the use made of the material. The volume expressed in board feet includes only the saw-timber portion of the stem of both pines and hardwoods, while the material expressed in cubic feet includes saw-timber material, upper stems of sawlog-size pines, and total stems of trees below sawlog size. Utilization drain, as used here, includes material cut and utilized, as well as any additional usable material left in the woods as a result of cutting. Although the unit embraces the largest oil field in the world, and is crisscrossed by oil and gas lines, wood remains the most widely used fuel; the magnitude of this use in 1937 is shown by the fact that the use of wood for fuel was second only to its use for lumber.

Table 13. - Utilization drain from sound trees, 1937

Commodity	Saw-timber material			All material		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	- -Thousand board feet- -			- -Thousand cubic feet- -		
Lumber	306,700	47,100	353,800	59,930	6,820	66,750
Cross ties	51,600	21,000	72,600	9,900	3,460	13,360
Poles and piles	8,400	500	8,900	1,970	90	2,060
Veneer	3,000	18,400	21,400	510	2,640	3,150
Misc. manufactures	2,000	6,600	8,600	360	950	1,310
Pulpwood	2,100	-	2,100	910	-	910
Fuel wood	82,700	58,300	141,000	25,210	16,950	42,160
Fence posts	400	10,000	10,400	400	2,590	2,990
Misc. farm use and land clearing	13,100	13,700	26,800	4,890	7,840	12,730
Total	470,000	175,600	645,600	104,080	41,340	145,420

Comparison of Increment and Drain

The relation of forest increment to forest drain in 1937 is presented in board feet in table 14 and in cubic feet, inside bark, in table 15. In the saw-timber material, there was an over-drain in both pine and hardwoods, as the total cut exceeded total increment by 17 percent, or 92 million feet.

This is a small reduction over 1936, in which the board-foot drain exceeded increment by 20 percent. In 1935, during which industrial activity was somewhat less than in the 2 following years, forest increment exceeded the drain by 1 percent. In 1937 the cut of old-growth pine timber was about three times its increment, and in the hardwoods it is estimated that the use of old-growth timber was about one and one-third times its increment. Although the old-growth stands will be soon exhausted at the prevailing rate of use, this does not imply any material change in the character of the forest industries of the unit, as they are all using considerable second-growth timber at the present time. Since saw timber, both the old growth and second growth, is being cut

faster than it is growing, it follows that the growing stock and the increment must be increased if an eventual reduction of industrial activity is to be avoided.

Table 14. - Balance between increment and drain of saw-timber material

Item	Pines	Hardwoods	Total
	- - - Thousand board feet - - - - -		
Net growing stock Jan. 1, 1937	5,702,200	3,013,700	8,715,900
Growth, 1937	448,700	179,400	628,100
Mortality, 1937	39,800	34,800	74,600
Forest increment, 1937	408,900	144,600	553,500
Utilization drain, 1937	470,000	175,600	645,600
Net change in growing stock, 1937	-61,100	-31,000	-92,100
Net growing stock Jan. 1, 1938	5,641,100	2,982,700	8,623,800

The increment and drain for the entire sound-tree growing stock 5.0 inches d.b.h. and larger, are compared in table 15. During 1937 the cubic-foot drain exceeded the increment by 1.4 percent. The overcutting was chiefly in the pine, as the hardwoods show a slight surplus. Although the pine was overcut by 3.5 million cubic feet in 1937, the growing stock of pine at the beginning of 1938 was 17 million feet more than at the time of the inventory in 1935. In the hardwoods, the growing stock increased 7 million cubic feet during the same period. The net result was to increase the total cubic-foot growing stock nearly 1 percent during the 3-year interval, even though the saw-timber volume was reduced 2 percent.

Table 15. - Balance between increment and drain in cubic feet

Item	Pines	Hardwoods	Total
	- - - Thousand cubic feet - - - - -		
Net growing stock, Jan. 1, 1937	1,759,980	1,201,990	2,961,970
Growth, 1937	115,800	62,250	178,050
Mortality, 1937	15,260	19,440	34,700
Forest increment, 1937	100,540	42,810	143,350
Utilization drain, 1937	104,080	41,340	145,420
Net change in growing stock, 1937	-3,540	1,470	-2,070
Net growing stock, Jan. 1, 1938	1,756,440	1,203,460	2,959,900

Summary and Future Outlook

In this unit, the land is used chiefly for agriculture, timber growth, and petroleum production. The oil field occupies less than 5 percent of the total land area, but its industrial development and annual petroleum yields are worth millions of dollars. In addition, the oil industry has stimulated the leasing of land throughout the unit, providing a supplementary income to many landowners. Petroleum, however, is an exhaustible resource, and the rapid exploitation of this huge reservoir of material that has accumulated through the ages has set up temporary economic standards in parts of the unit that the renewable resources cannot, and should not be expected to, maintain. It is inevitable that there will be an economic decline when the petroleum industry is gone, but its severity can be reduced if the people and local governments take immediate steps to foster supplementary resources and industries.

Agriculture is an important activity in this area, but between 1924 and 1937 there was a shrinkage of approximately 576,000 acres in the area devoted to cotton growing. It is estimated that the area of cotton harvested in 1937 required nearly 5 million man-days of labor less than the acreage in 1924. This vitally affects the rural farm population; and that the situation has not been remedied is indicated by the Unemployment Census of November 1937, which showed in this survey unit over 38,000 people unemployed or on relief at that time.

Opportunity for increasing employment on a large scale by producing agricultural crops seems remote, unless new crops can be developed to utilize even more intensively the land formerly planted to cotton. On the other hand, timber production offers an opportunity to modify the probable economic decline in the oil-field area, as well as contribute toward a higher income for a large part of the population of the region. At the outset it should be remembered that the forest industries at present are depleting the saw-timber stands faster than they are growing, while the demand for timber probably will become even greater as small-home construction increases, industrial needs revive, and chemical uses of wood expand. In addition, the successful manufacture of newsprint by the projected pulp mill at Lufkin, Texas, may cause an unprecedented demand for forest products. To meet these increased requirements, or even to maintain the present growing stock, it is absolutely essential that improved forestry practices be immediately undertaken. Otherwise, the forest resource will steadily decrease, leaving the people more and more dependent upon a shrinking agriculture and a temporary petroleum industry.

It is obvious from the above discussion that the forest lands in this unit must be made more productive, for which purpose the following measures are necessary:

(1) The immediate need is for an intensification and extension of the present system of fire protection. Although about 70 percent of the forest land was protected in 1936, most of the forest has suffered from periodic burning, as a result of which it is greatly understocked. Fire protection is the most practical method of increasing the growing stock in this area, where all of the increment is needed to maintain the present forest industries. Reserving a portion of the increment to build up the growing stock is usually desirable, but such a program in this unit, if not done gradually and with full appreciation of the needs of the industry, would add to the already appalling total of unemployment.

(2) An extension program emphasizing the best practices of farm forestry is essential, because 52 percent of the forest land is in farm ownership. Since there are 79,000 farm operators, the task is a huge one, and it is likely that at least one extension forester would be required in each county to obtain the maximum results. Approximately $50,000 would be needed annually for salaries, but the returns from good forest practice on more than half the forest land in the unit justifies this expenditure.

(3) A planting program is needed to reforest the 700,000 acres of idle and abandoned agricultural land. The State should assist the landowner by furnishing nursery stock at nominal cost.

(4) More demonstration forests that are publicly owned should be established. These must be numerous enough to be conveniently accessible to the timber land operators, so that they may learn the best technique of timber growing.

(5) Additional State and Federal participation is required to provide funds or legislation for increased protection against fire and trespass, cheap credit for sustained-yield enterprises, assurance of reasonable taxation, an adequate research program, and the establishment of freight rates on lumber comparable with those in adjacent Southern States.

The successful accomplishment of these several measures should greatly increase the supply of raw material and permit a permanent expansion of the forest industries. New industries should be established as fast as the annual yield permits, since only through full utilization of the increment will it be possible to increase the forest employment, return idle lands to productivity, and soften the economic shock that is certain to come when the oil resource is exhausted.